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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

ANTHONY J. KONECNI ET AL.

Serial No. 08/988,686 (TI-22166)

Filed December 11, 1997

For: PLASMA PRE-TREATMENT TO REMOVE RESIDUES FORMED IN A VIA

Art Unit 2823

Examiner K. Eaton

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Commissioner for Patents
Washington, D. C. 20231

Sir:

BRIEF ON APPEAL

REAL PARTY IN INTEREST

The real party in interest is Texas Instruments Incorporated, a Delaware corporation with offices at 7839 Churchill Way, Dallas, Texas 75251.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals and/or interferences.

STATUS OF CLAIMS

This is an appeal of the rejection of claims 21 to 32, all of the rejected claims. No claims have been allowed, claims 1 to 15 have been cancelled and claims 16 to 20 have been withdrawn from consideration. Please charge any costs to Deposit Account No. 20-0668.

06/04/2001

STATUS OF AMENDMENTS

No amendment was filed after the prior but subsequent to the first rejection.

SUMMARY OF INVENTION

The invention relates to a method of fabricating an electronic device having a first electrically conductive structure electrically (e.g., 22 or 24) connected to a second electrically conductive structure (e.g., 24 or 28 [22 is erroneously omitted from portion 12]) situated over a semiconductor substrate (16). The method comprises the steps of forming a first electrically conductive structure (22 or 24), forming an insulating layer (20 or 26) extending above the first conductive structure, the insulating structure having an opening with sidewalls and a bottom exposing at least a portion of the first conductive structure (32 or 34). A halogen-free gas comprised of hydrogen (46 and page 5, lines 7 to 13 and page 15, lines 3 to 7) is incorporated within a plasma into the opening in the insulating layer and onto the exposed portion of the first conductive layer to increase the reactive surface of any residual material on the exposed portion and at least partially remove the residue material (40) from the opening. Then a conductive material (24 or 28 or 60 of Fig. 4) is deposited into the opening and onto the exposed portion using chemical vapor deposition (CVD). The plasma can additionally be comprised of the inert gases of helium or argon to increase the area of the residue 40 exposed for reaction with the hydrogen plasma. The conductive material is preferably comprised of a metal selected from the group consisting of: aluminum, copper, titanium, and a combination thereof.

ISSUES

The issues on appeal are as follows:

ISSUE 1

Whether claims 21 to 26, 29 and 30 are patentable over Japanese Patent No. 4-171,744 under 35 U.S.C. 103(a).

ISSUE 2

Whether claims 27, 28, 31 and 32 are patentable over Japanese Patent No. 4-171,744 in view of Pan (presumably U.S. 6,008,139) under 35 U.S.C. 103(a).

GROUPING OF CLAIMS

The claims do not stand or fall together for reasons set forth hereinbelow under ARGUMENT.

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ARGUMENT

ISSUE 1

Claims 21 to 26, 29 and 30 were rejected as being unpatentable over Japanese Patent No. 4-171,744 under 35 U.S.C. 103(a). The rejection is without merit.

Claim 21 relates to a method of fabricating an electronic device having a first conductive structure electrically connected to a second conductive structure situated over a semiconductor substrate, the method comprising the steps of: forming the first conductive structure and forming an insulating layer extending above the first conductive structure, the insulating structure having an opening with sidewalls and a bottom and exposing a portion of the first conductive structure. The claim up to this point is admittedly old in the art. The principal inventive feature set forth in

the claims on appeal relates to the step of removing residue from the opening by providing a halogen-free gas comprised of hydrogen incorporated within a plasma into the opening in the insulating layer and onto the exposed portion of the first conductive layer to increase the reactive surface of any residual material on the exposed portion and at least partially remove the residual material and then depositing a conductive material into the opening using chemical vapor deposition. The advantage of this type of chemistry is set forth on page 5 of the specification which is that high ion energies are not required , thereby reducing or eliminating the undesirable deformation of high aspect ratio features or topologically sharp features often associated with modern semiconductor devices. As stated at page 3 of the specification, the prior art utilized chlorine or bromine (halogen-containing) chemistries that provided serious problems which are overcome by use of the chemistry of the present invention.

A review of the Japanese patent clearly indicates that the chemistry used is the undesirable prior art chemistry mentioned in the subject specification, namely halogen chemistry, halogens being fluorine (F), chlorine (Cl), bromine (Br) and iodine (I). Note in the Abstract of the Japanese patent that fluorine (F) as well as hydrofluoric acid (HF) are present, these being a halogen and a halogen-containing material respectively. In addition, the use of a hydrogen plasma chemistry is nowhere taught or even remotely suggested in the Japanese patent. It follows that the inventive concept of the claims on appeal is nowhere taught or even remotely suggested by the cited reference.

Claims 22 to 26, 29 and 30 depend from claim 21 and therefore define patentably over the Japanese patent for at least the reasons set forth above with reference to claim 21.

In addition, claim 22 further limits claims 21 by requiring that the gas be additionally comprised of helium. No such combination is taught or suggested by Nakata.

Claim 23 further limits claim 22 by requiring that the gas be additionally comprised of argon. No such combination is taught or suggested by the Japanese patent.

Claim 24 further limits claim 21 by requiring that the conductive material be comprised of a metal selected from the group consisting of: aluminum, copper, titanium, and a combination thereof. No such combination is taught or suggested by the Japanese patent.

Claim 25 further limits claim 21 by requiring that the gas comprised of hydrogen incorporated within a plasma remove residue formed in the opening in the insulating layer. No such combination is taught or suggested by the Japanese patent.

Claim 26 further limits claim 21 by requiring that the plasma have a plasma power of from about 150 watts to about 450 watts. No such combination is taught or suggested by the Japanese patent.

Claims 29 and 30 further limit claims 21 and 26 by requiring that the step of providing a gas into the opening be at a temperature of from about 100°C to about 450°C. No such combination is taught or suggested by the Japanese patent.

ISSUE 2

Claims 27, 28, 31 and 32 were rejected under 35 U.S.C. 103(a) as being unpatentable over the Japanese Patent 4-171,744 in view of Pam (presumably U.S. 6,008,139). The rejection is without merit.

All of these claims depend from claim 21 and therefore define over the cited references for at least the reasons presented above with reference to claim 21 since Pam fails to overcome the deficiencies in the Japanese patent as above enumerated.

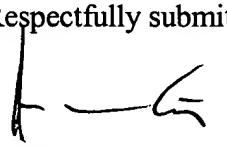
In addition, claims 27 and 28 further limit claim 21 and 26 by requiring that the plasma have a bias power of up to about 300 watts. No such combination is taught or suggested by the Japanese patent, Pam or any proper combination of these references.

Claims 31 and 32 further limit claims 27 and 28 by requiring that the step of providing a gas into the opening be at a temperature of from about 100°C to about 450°C. No such combination is taught or suggested by the Japanese patent, Pam or any proper combination of these references.

CONCLUSIONS

For the reasons stated above, reversal of the final rejection and allowance of the claims on appeal is requested that justice be done in the premises.

Respectfully submitted,



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APPENDIX

The claims on appeal read as follows:

21. A method of fabricating an electronic device having a first electrically conductive structure electrically connected to a second electrically conductive structure situated over a semiconductor substrate, said method comprising the steps of:

forming said first electrically conductive structure;

forming an insulating layer extending above said first electrically conductive structure, said insulating structure having an opening with sidewalls and a bottom and exposing a portion of said first conductive structure;

providing a halogen-free gas comprised of hydrogen incorporated within a plasma into said opening in said insulating layer and onto the exposed portion of said first conductive layer to increase the reactive surface of any residual material on said exposed portion and at least partially remove said residual material ; and

then depositing a conductive material into said opening and onto said exposed portion using chemical vapor deposition.

22. The method of claim 21, wherein said gas is additionally comprised of helium.

23. The method of claim 21, wherein said gas is additionally comprised of argon.

24. The method of claim 21, wherein said conductive material is comprised of a metal selected from the group consisting of: aluminum, copper, titanium, and a combination thereof.

25. The method of claim 21, wherein said gas comprised of hydrogen incorporated within a plasma removed residue formed in said opening in said insulating layer.

26. The method of claim 21 wherein said plasma has a plasma power of from about 150 watts to about 450 watts.

27. The method of claim 21 wherein said plasma has a bias power up to about 300 watts.

28. The method of claim 26 wherein said plasma has a bias power up to about 300 watts.

29. The method of claim 21 wherein said step of providing a gas into said opening is at a temperature of from about 100°C to about 450°C.

30. The method of claim 26 wherein said step of providing a gas into said opening is at a temperature of from about 100°C to about 450°C.

31. The method of claim 27 wherein said step of providing a gas into said opening is at a temperature of from about 100°C to about 450°C.

32. The method of claim 28 wherein said step of providing a gas into said opening is at a temperature of from about 100°C to about 450°C.